

Optimization of Simultaneous Facial EMG and fMRI

The scientific study of emotion began in the 19th century with Duchenne's study of the "universal and immutable" language of facial expressions. In *The Mechanism of Human Physiognomy*, he manipulates human facial expressions by electrically stimulating facial muscles. Facial electromyography (EMG) is a modern technique that is reminiscent of Duchenne's work; it allows researchers to measure facial muscle activity through surface recording electrodes, providing a real-time measure of natural emotional reactions.

Although facial EMG is a reliable measure of emotional behavior, it fails to provide any information about brain activity responsible for emotional processes. Functional magnetic resonance imaging (fMRI) can fill this gap, but facial EMG and fMRI are rarely used simultaneously because the electromagnetic field produced by MRI complicates traditional EMG recording. The present study aims to address this challenge and optimize a protocol for simultaneous EMG and fMRI recording.

We plan to use a BIOPAC EMG100C-MRI amplifier to record facial EMG while participants are scanned in a 3 Tesla MRI. To reduce electromagnetic noise interference with the EMG signal, we will determine optimal scanning parameters and arrangement of electrodes and cables. Remaining noise will be removed by a series of analog and digital filters. For example, a comb band stop filter targeting the electromagnetic frequencies of the MRI could be applied during preprocessing.

This novel, multi-modal approach is a logical next step for the field of emotion research. Furthermore, this protocol could be extended to other areas of research and clinical applications.